NASA Landing Site/Exploration Zone for the First Human Missions [#1022]

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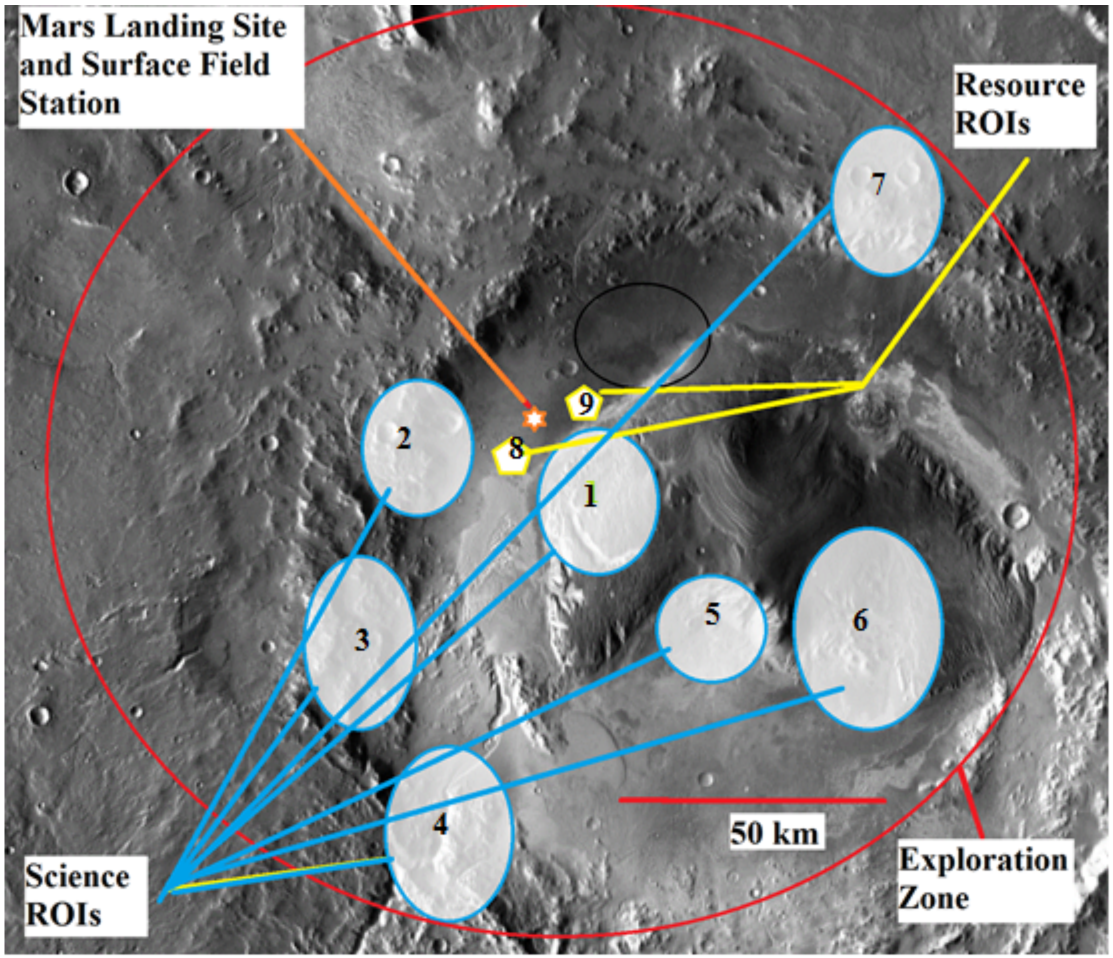
Latitude and Longitude: 4.6°S 137°E

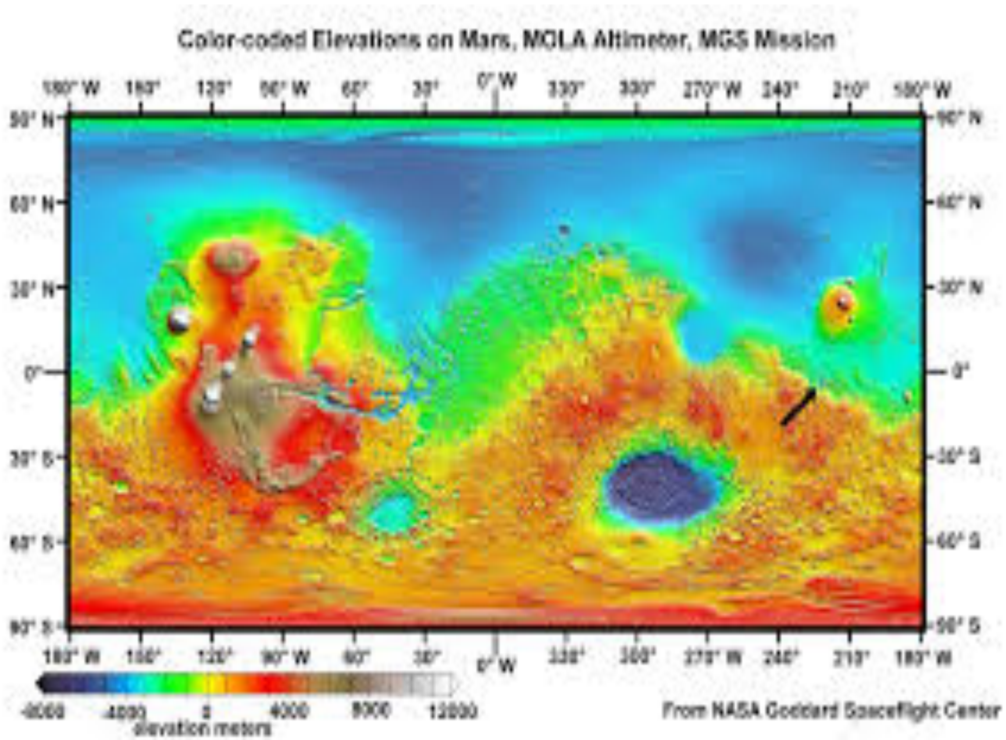


Latitude: 4.6 degrees South

(Located between +/- 50 degrees latitude)

Elevation: -4.5 km MOLA

(Less than +2 km altitude)



RUBRICS

Science ROI(s) Rubric

Science Site Criteria			Site Factors	EZ1 (ROI 1)	EZ1 (ROI 2)	EZ1 (ROI 3)	EZ1 (ROI 4)	EZ1 (ROI 5)	EZ1 (ROI 6)	EZ1 (ROI 7)	EZ1 (ROI 8)	EZ1 (ROI 9)	EZ1 SUM
Science Site Criteria	Astrobio	Threshold	AND/OR Potential for past habitability	○	●	●	●	●	●	○	●	●	2,3,4,5,6,8,9(1,7)
			Potential for present habitability/refugia		●	○	○	○	○		●	●	2,8,9 (3,4,5,6,)
		Qualifying	Potential for organic matter, w/ surface exposure		○	○	○	●		●	●	●	5,7,8,9 (2,3,4)
	Atmospheric	Threshold	Noachian/Hesperian rocks w/ trapped atmospheric gases	●	○	○		○	○	○			1(2,3,5,6,7)
		Qualifying	Meteorological diversity in space and time	●	○	○	○	○	○	○	○	○	1(2,3,4,5,6,7,8,9)
			High likelihood of surface-atmosphere exchange	●		○			○	○			1(3, 6, 7)
			Amazonian subsurface or high-latitude ice or sediment	●				○	○				1(5,6)
			High likelihood of active trace gas sources	●	○			○	○	○			1(2,5,6,7)
	Geoscience	Threshold	Range of martian geologic time; datable surfaces	●				○	○				1(5,6)
			Evidence of aqueous processes	○		●	●	○	○				3,4(1,5,6)
			Potential for interpreting relative ages	●				○	○				1(5,6)
		Qualifying	Igneous Rocks tied to 1+ provinces or different times	●	○					○			1(2,7)
			Near-surface ice, glacial or permafrost		○		○	○			●	●	8,9(2,4,5)
			Noachian or pre-Noachian bedrock units	●				○	○				1(5,6)
			Outcrops with remnant magnetization	●	○			○	○	○			1(2,5,6,7)
			Primary, secondary, and basin-forming impact deposits	●				○	○		●	●	1,8,9(5,6)
			Structural features with regional or global context	●	○	○	○	●	●	○			1,5,6 (2,3,4,7)
			Diversity of aeolian sediments and/or landforms	●	○	○	○	●	●	○	○	○	1,5,6(2,3,4,7,8,9)

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Resource ROI(s) Rubric

Criteria	Category	Level	Site Factors	EZ1 (ROI 1)	EZ1 (ROI 2)	EZ1 (ROI 3)	EZ1 (ROI 4)	EZ1 (ROI 5)	EZ1 (ROI 6)	EZ1 (ROI 7)	EZ1 (ROI 8)	EZ1 (ROI 9)	EZ1 SUM
ISRU and Civil Engineering Criteria	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)										YES
	Water Resource	Threshold	AND/OR: Potential for ice or ice/regolith mix		○	○	○	○	○		●	●	8,9,(2,3,4,5,6,)
			AND/OR: Potential for hydrated minerals		○	○	○	○	○		●	●	8,9,(2,3,4,5,6,)
			Quantity for substantial production		○	○	○	○	○		●	●	8,9,(2,3,4,5,6,)
			Potential to be minable by highly automated systems		○	○	○	○	○		●	●	8,9,(2,3,4,5,6,)
			Located less than 3 km from processing equipment site								●	●	8,9
			Located no more than 3 meters below the surface		○	○	○	○	○		○	○	(2,3,4,5,6,8,9)
			Accessible by automated systems		○		○	○	○		○	○	(2,4,5,6,8,9)
		Qualifying	Potential for multiple sources of ice, ice/regolith mix **and** hydrated minerals		○	○	○	○	○		●	●	8,9,(2,3,4,5,6,)
			Distance to resource location can be >5 km		●	●	●	●	●		○	○	2,3,4,5,6(8,9)
			Route to resource location must be (plausibly) traversable		○	○	○	○	○		●	●	8,9,(2,3,4,5,6,)
	Civil Engineering	Threshold	~50 sq km region of flat and stable terrain with sparse rock distribution								●	●	8,9
			1–10 km length scale: <10°								●	●	8,9
			Located within 5 km of landing site location								●	●	8,9
		Qualifying	Located in the northern hemisphere										
			Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	○	○		○	○	○		●	●	8,9(1,2,4,5,6)
			Utilitarian terrain features		○	○	○	○	○	○	○	●	9(2,3, 4,5,6, 7,8)
	Food Production	Qualifying	Low latitude	●	●	●	●	●	●	●	●	●	1,2,3,4,5,6,7,8,9
			No local terrain feature(s) that could shadow light collection facilities	○				○	○	○	●	●	8,9(1,5,6,7)
			Access to water		○		○	○			●	●	8,9(2,4,5)
			Access to dark, minimally altered basaltic sands	●	○	○	○	○	○	○	○	●	1,9(2,3,4,5,6,7,8)
	Metal/Silicon Resource	Threshold	Potential for metal/silicon	●	○	○	○	○	○	○	●	●	1,8,9(2,3,4,5,6,7)
			Potential to be minable by highly automated systems		○	○	○		○		●	●	8,9(2,3,4,6)
			Located less than 3 km from processing equipment site								●	●	8,9
			Located no more than 3 meters below the surface	○	○	○	○	○	○	○	○	○	(1,2,3, 4,5,6,7, 8,9)
			Accessible by automated systems								○	○	(8,9)
		Qualifying	Potential for multiple sources of metals/silicon	○	○	○	○	○	○	○	●	●	8,9(1,2,3,4,5,6,7)
			Distance to resource location can be >5 km	●	●	●	●	●	●	●	○	○	1,2,3,4,5,6,7(8,9)
			Route to resource location must be (plausibly) traversable	○	○	○	○	○	○	○	●	●	8,9(1,2,3,4,5,6,7)

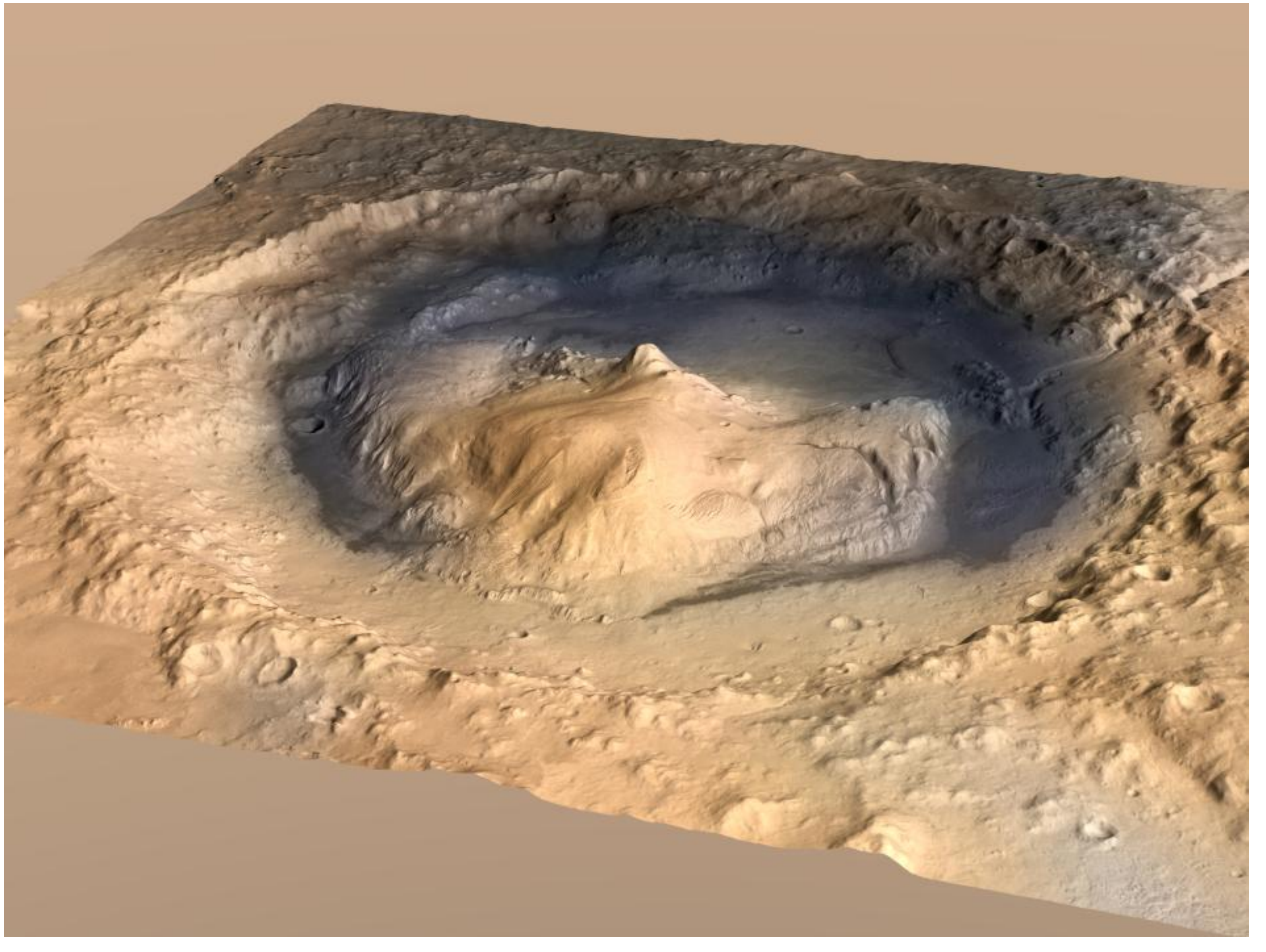
Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

SCIENCE ROIs

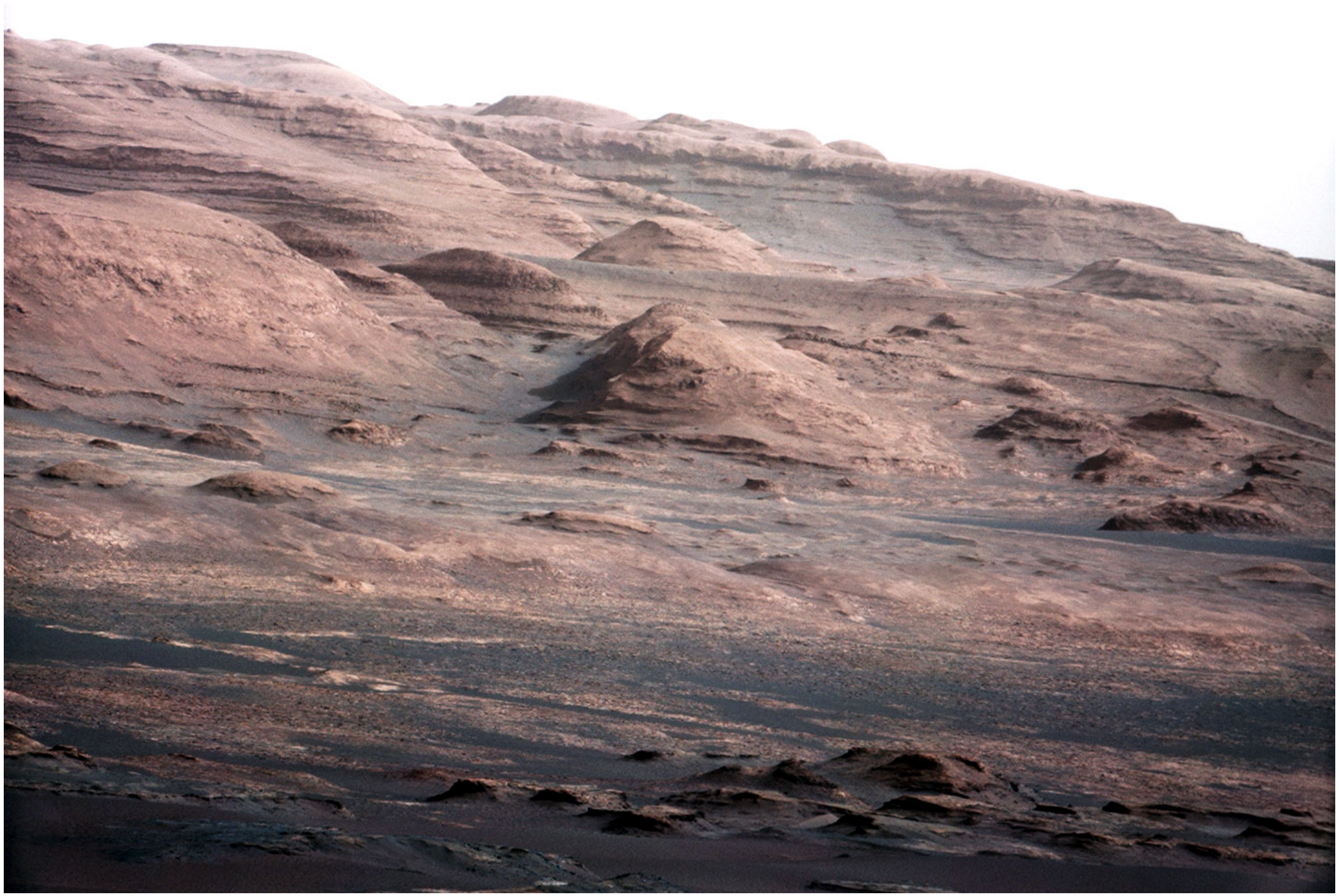
Human missions will deepen our understanding Mars with Curiosity's Insitu data.

- Mount Sharp of sedimentary layers
- Bottom of a lake
- Habitable environment
- Methane

Gale Crater was formed by a meteor impact about 3.5 to 3.8 billion years ago.



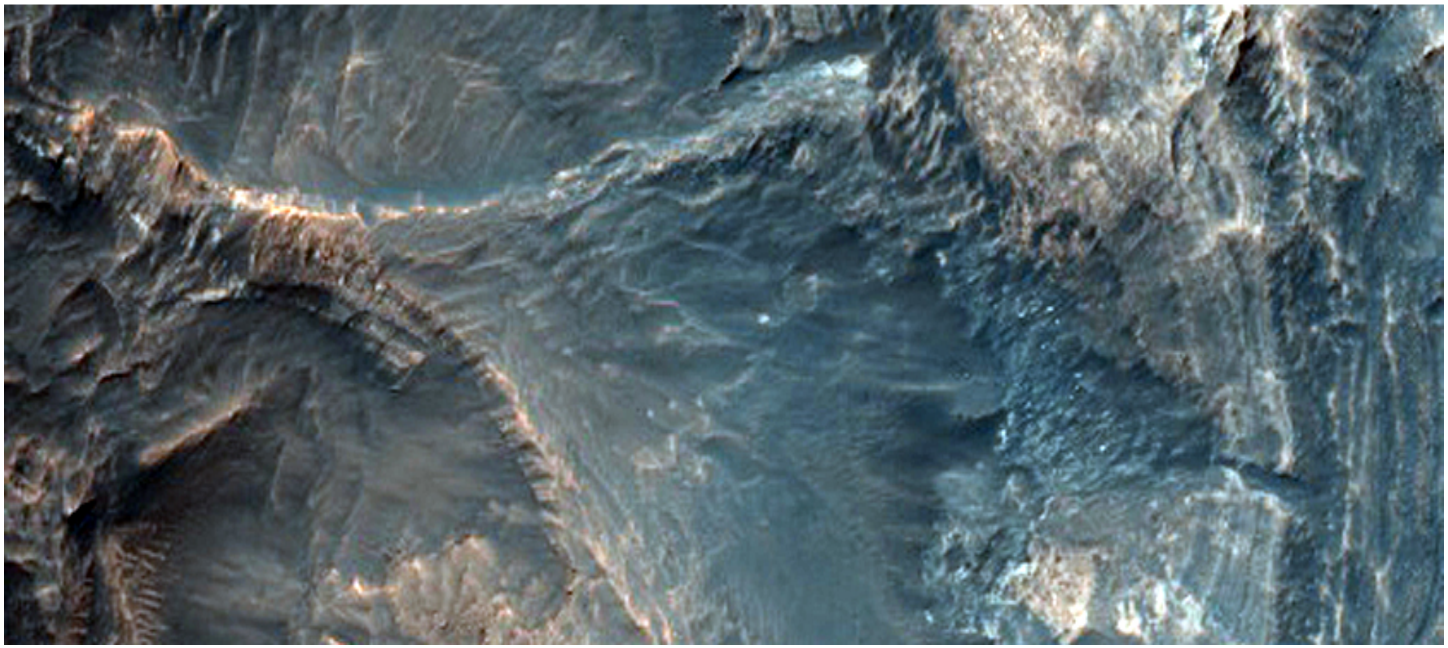
Aeolis Mons (Mount Sharp) of ~5km layered sedimentary Noachian and/or Hesperian rocks suitable for radiometric dating in a significant range of martian geological time



Near the bottom of the mound are clay minerals.

Repeated Sulfate and Clay Beds in West Gale Crater

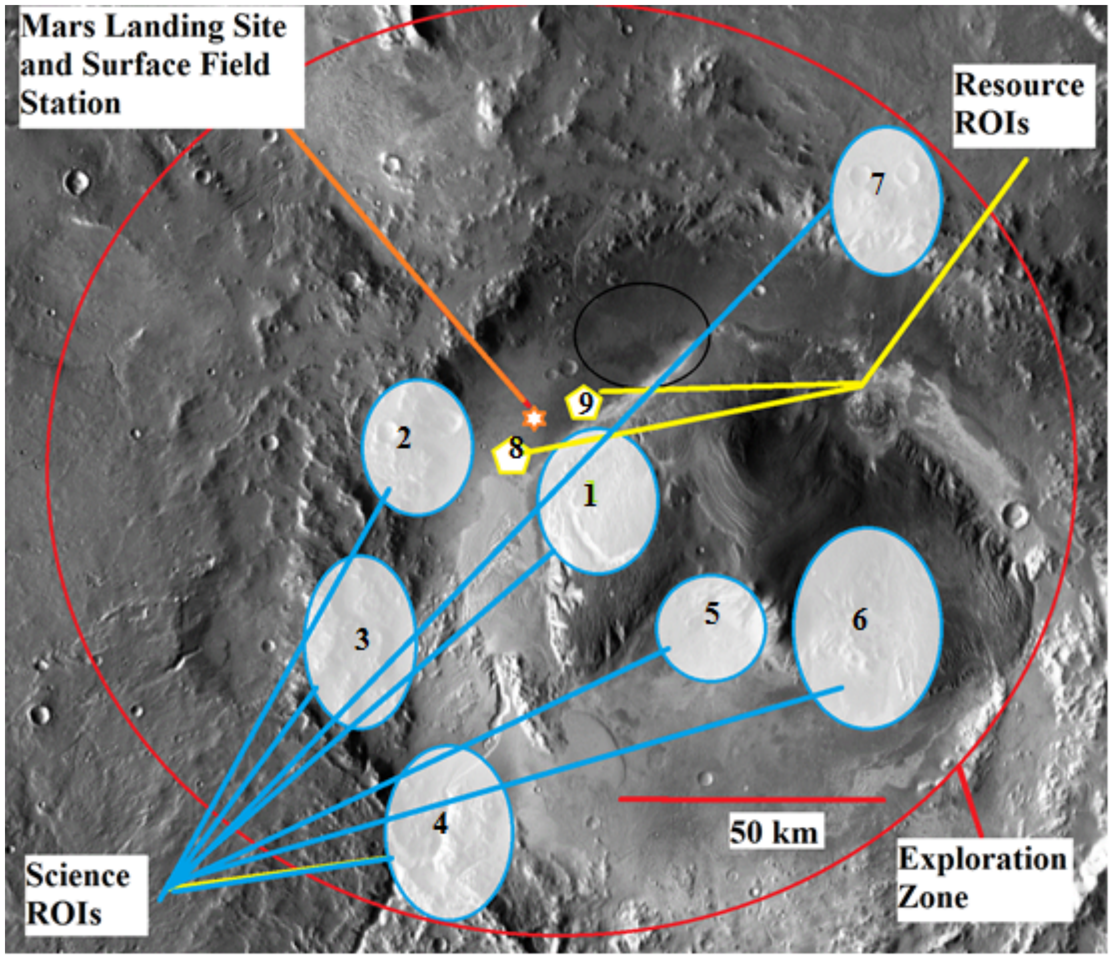
(Deposits with a high preservation potential for evidence of past habitability and fossil bio-signatures)



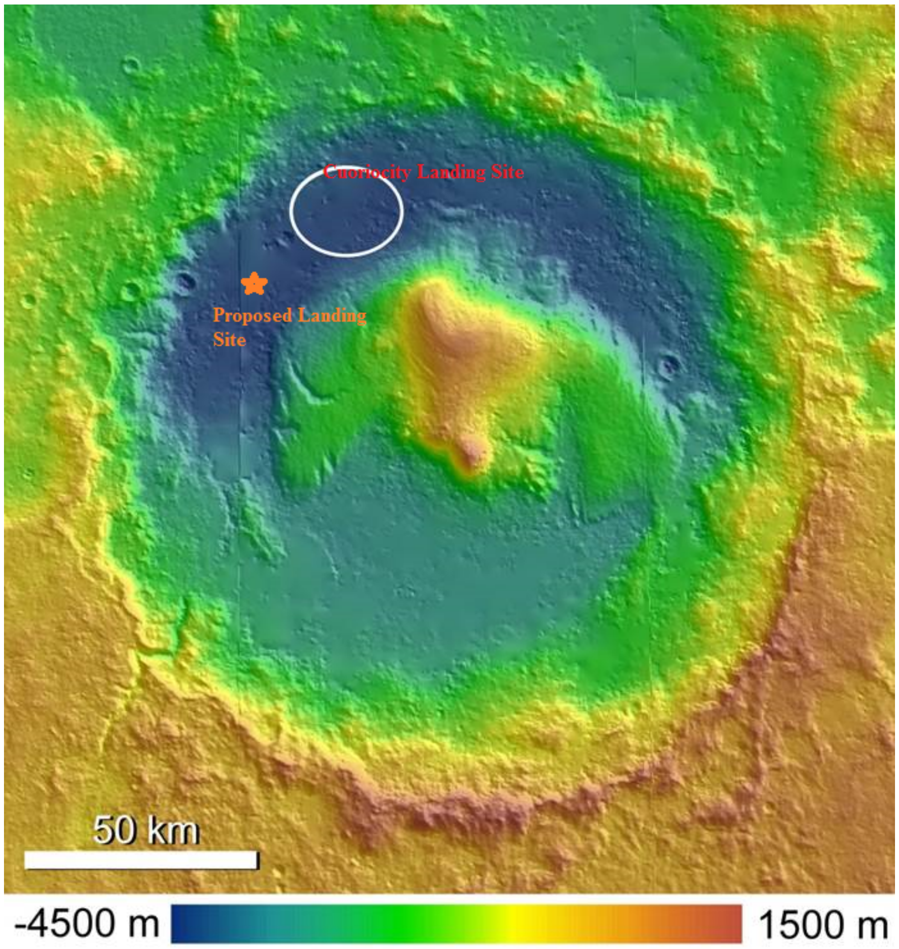
NASA/JPL/ University of Arizona

RESOURCE ROIs

Resource ROIs



Higher atmospheric density: Best known radiation shielding



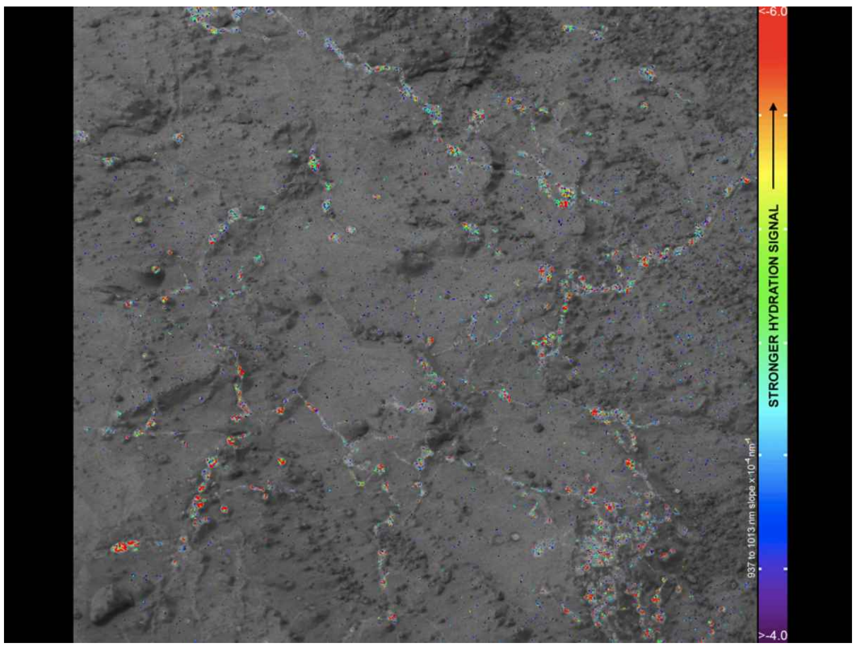
Hydrated Soil in Gale Crater

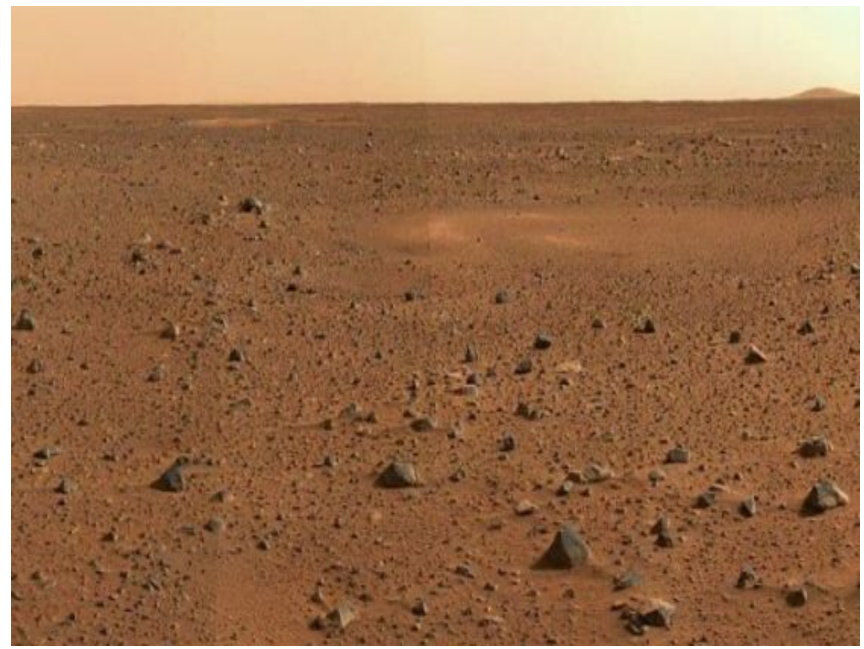
Hydrate Mineral

(2wt % H_2O)

Soil's amorphous component

(3 to 6 wt % H_2O)

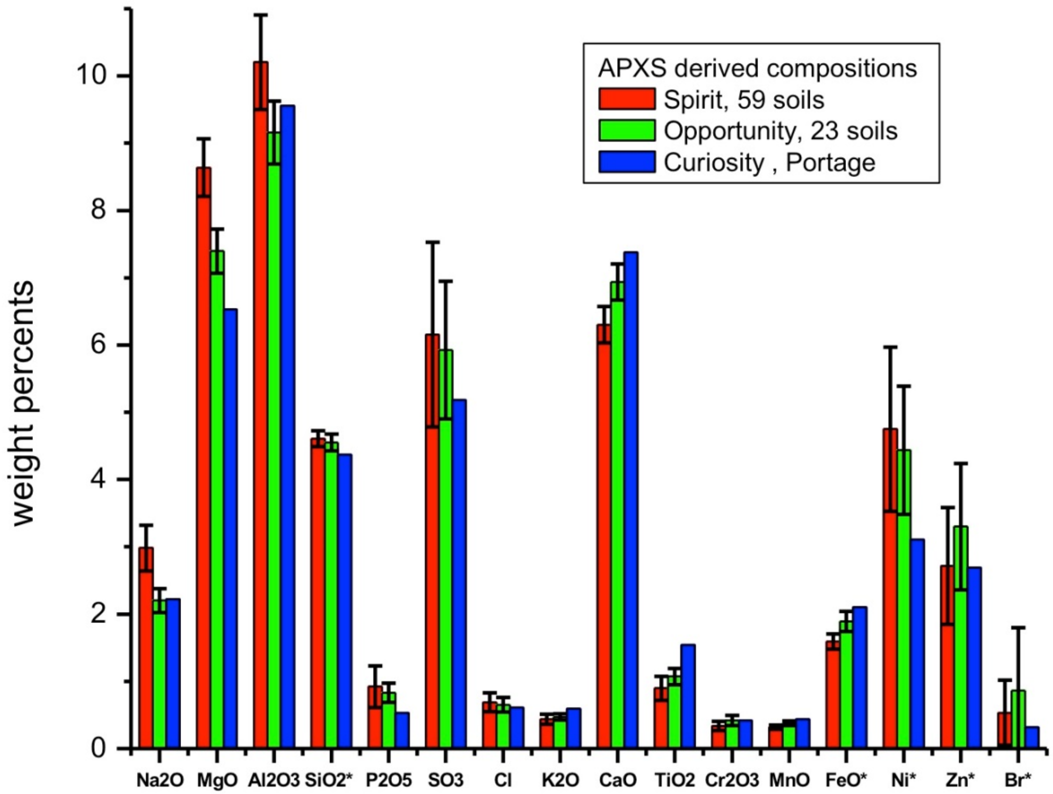




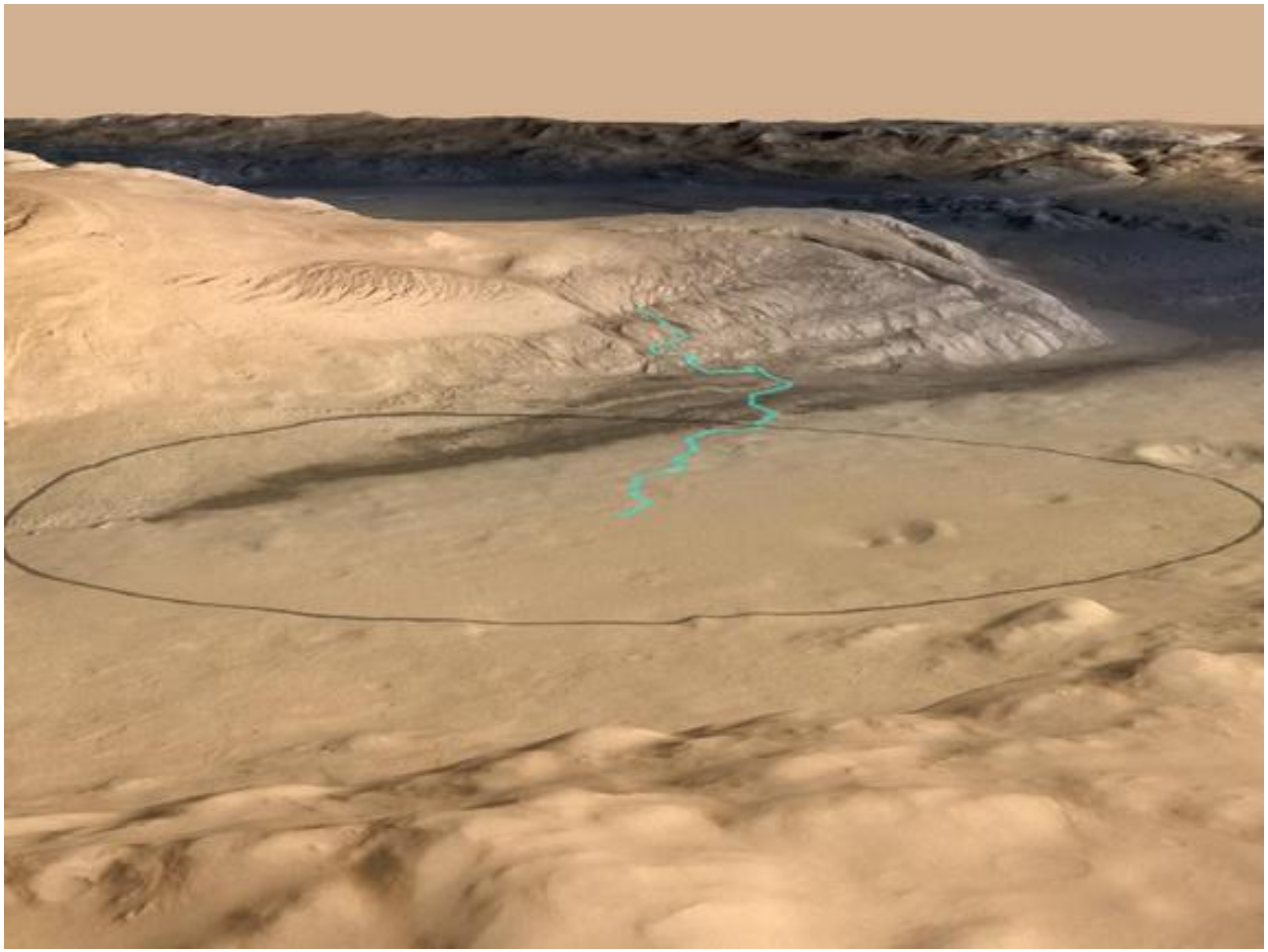
Gale Crater soil composition:

Plant macronutrients and micronutrients are available to complete life cycle.

Mars atmosphere is made of Carbon dioxide 95.32% & Nitrogen: 2.7%.

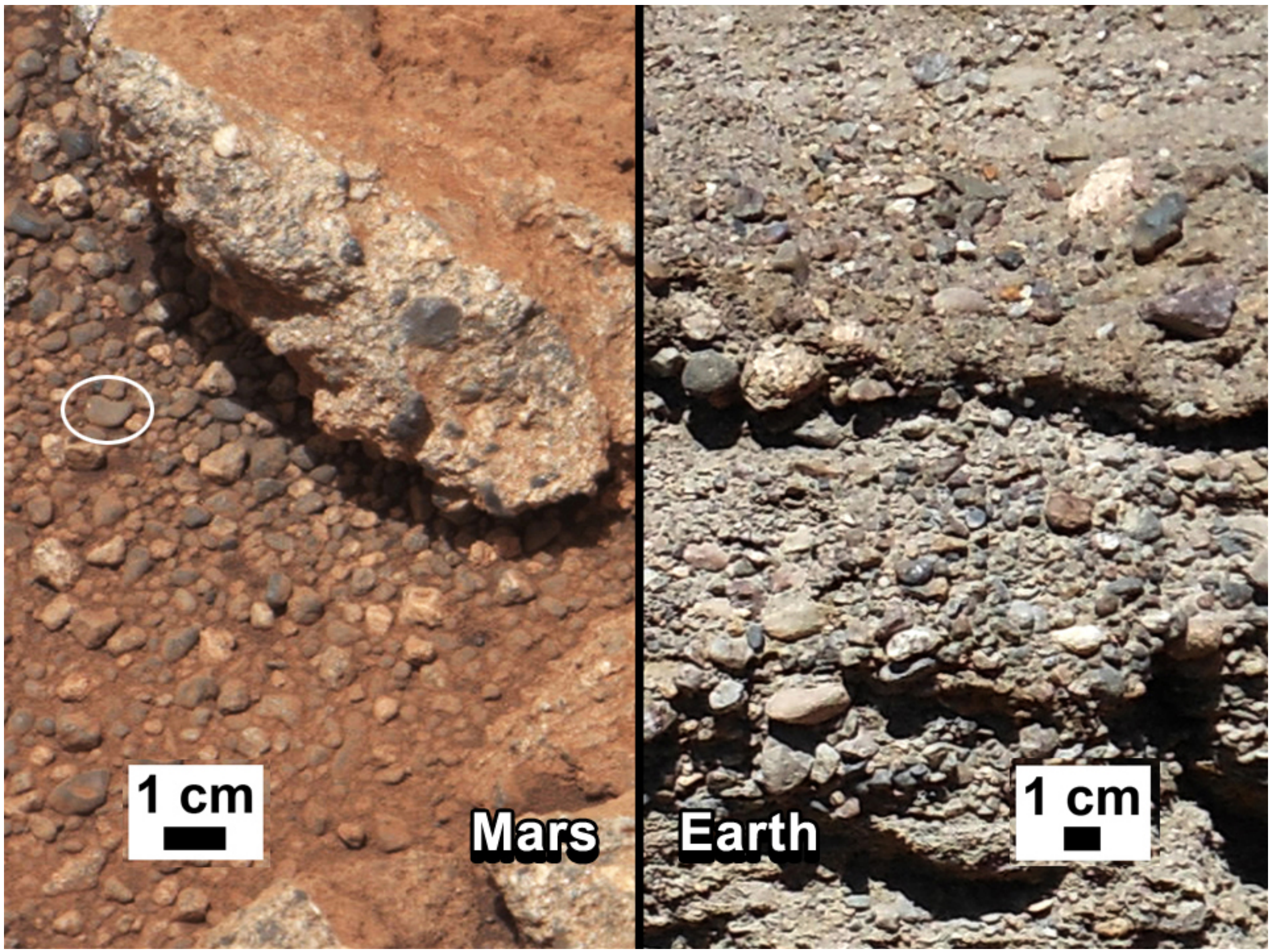


Nitrates found in Gale Crater: Nitrogen exists in soil.



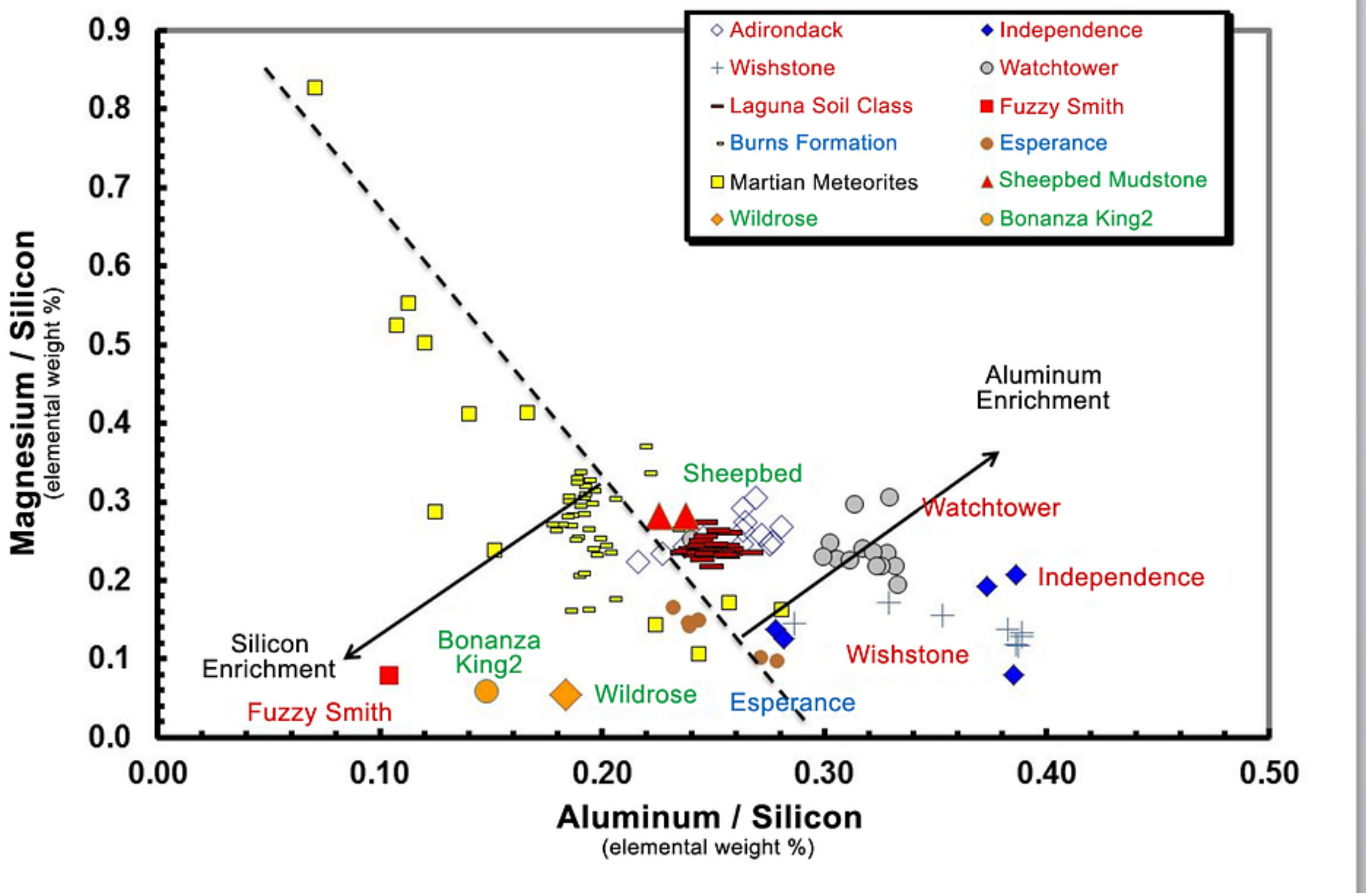
Cobble-sized or smaller rocks and bulk, loose regolith

Cobble-sized rocks



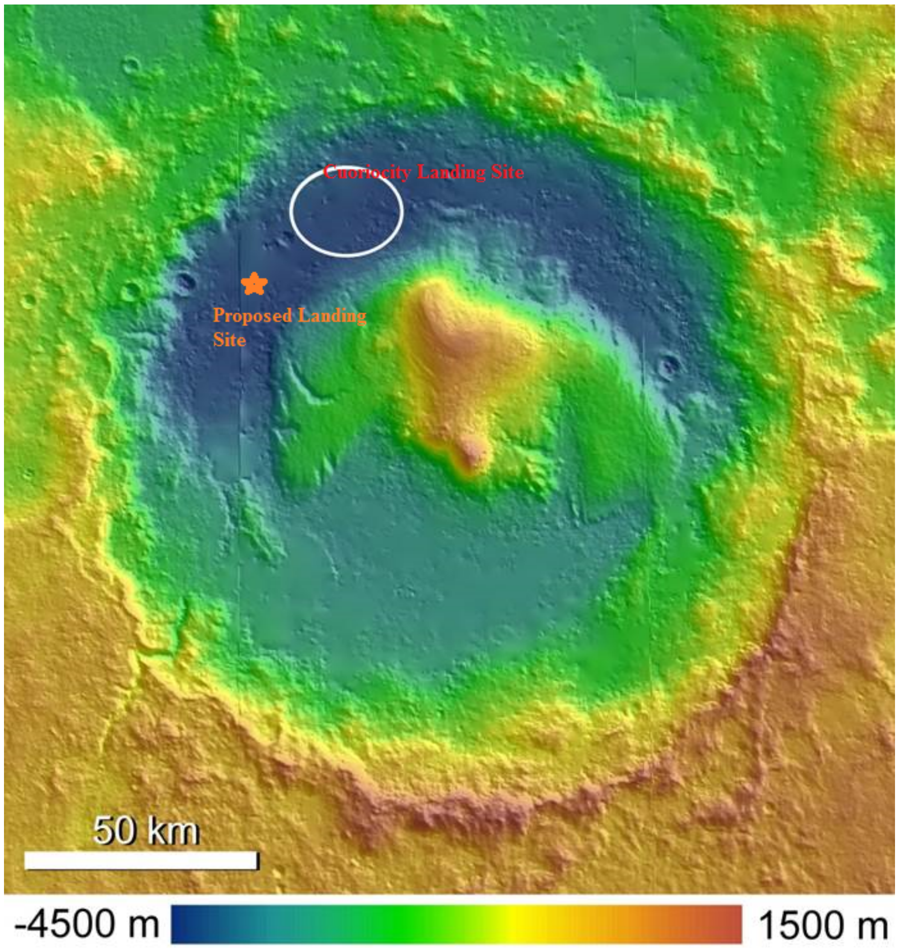
Iron Oxides

Silcon, Aluminum and Megnesium

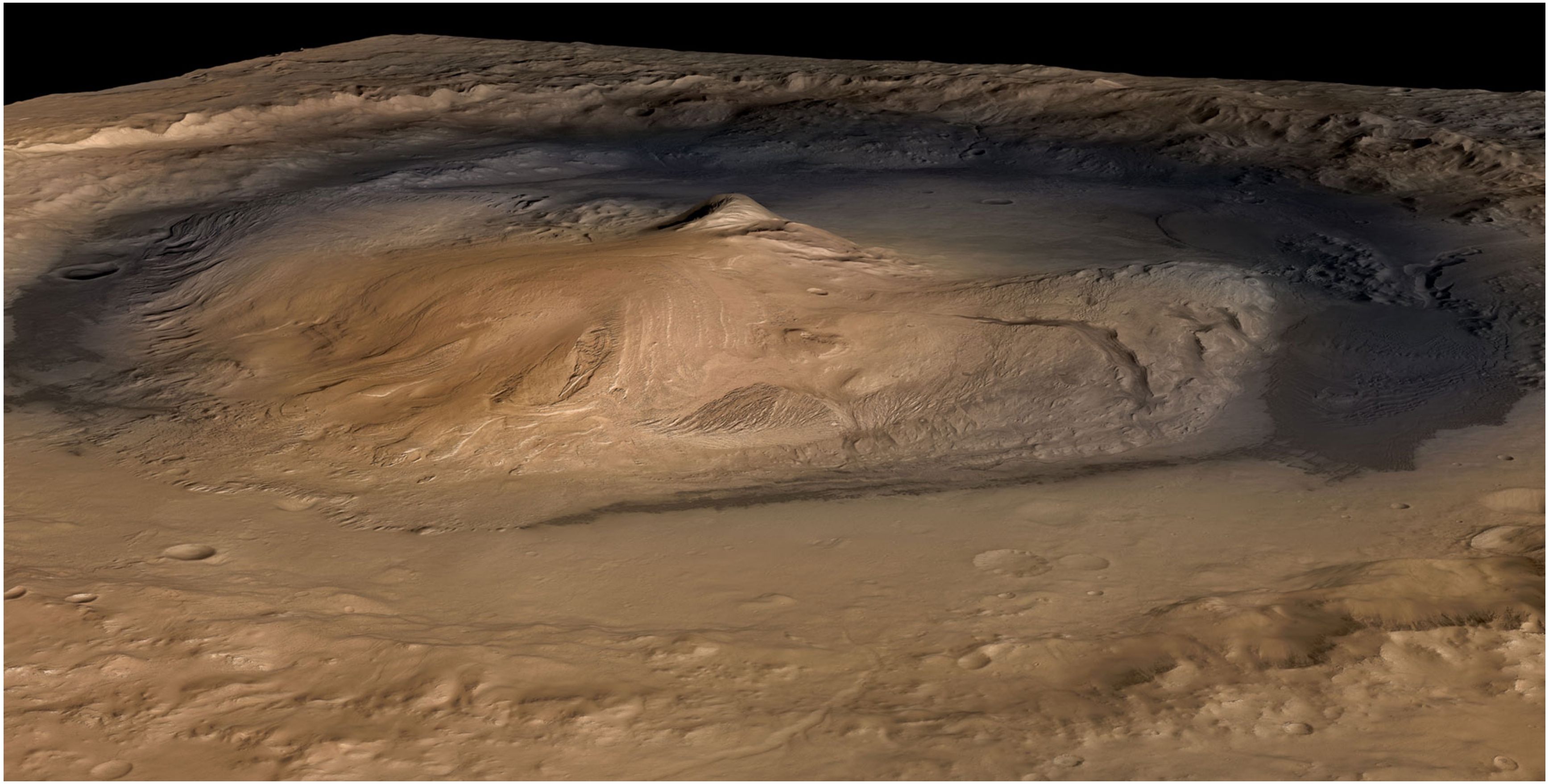


A plausible Mars landing site

Higher atmospheric density: Advantage on velocity reduction in landing



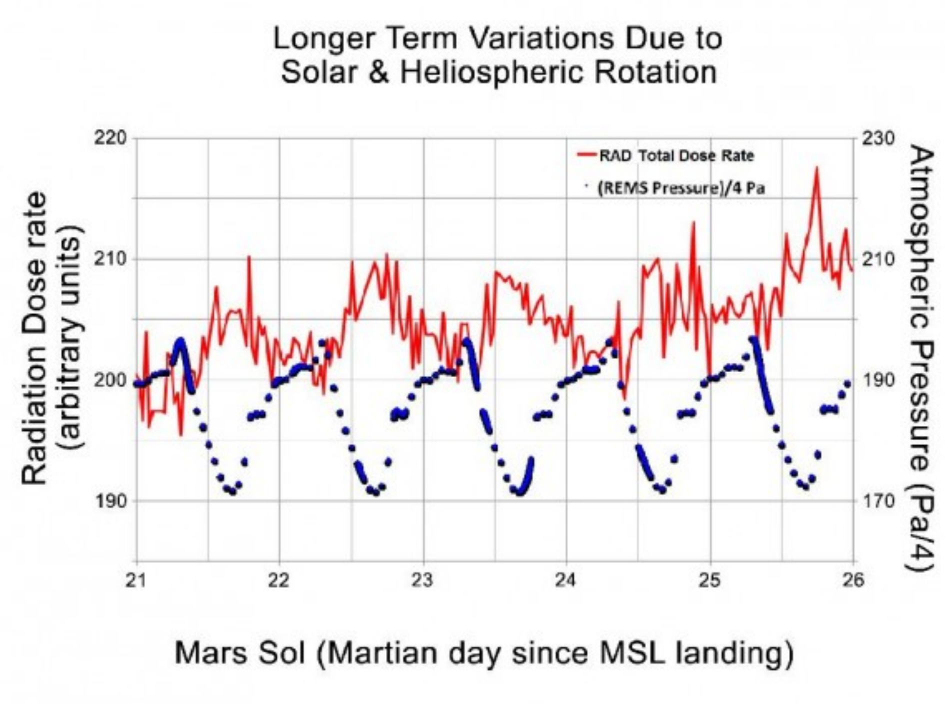
A flat area of approximately 25 km^2 of the terrain with slope less than ~10 degrees and without significant landing hazards including dust



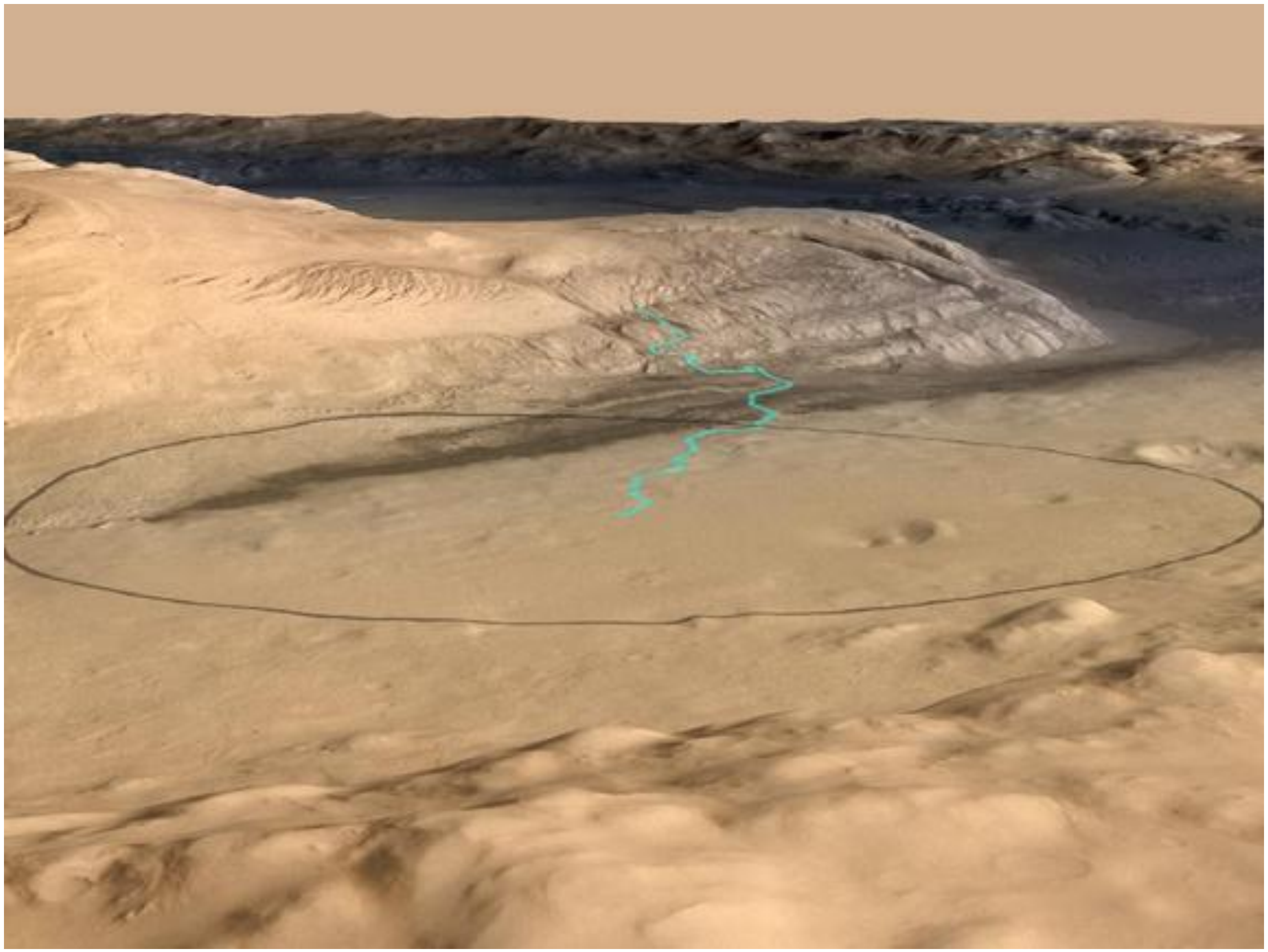
Curiosity’s Insitu data decrease risk for human missions , and reduce cost.

- Radiation
- Wind speed and direction
- Temperature
- Atmospheric pressure

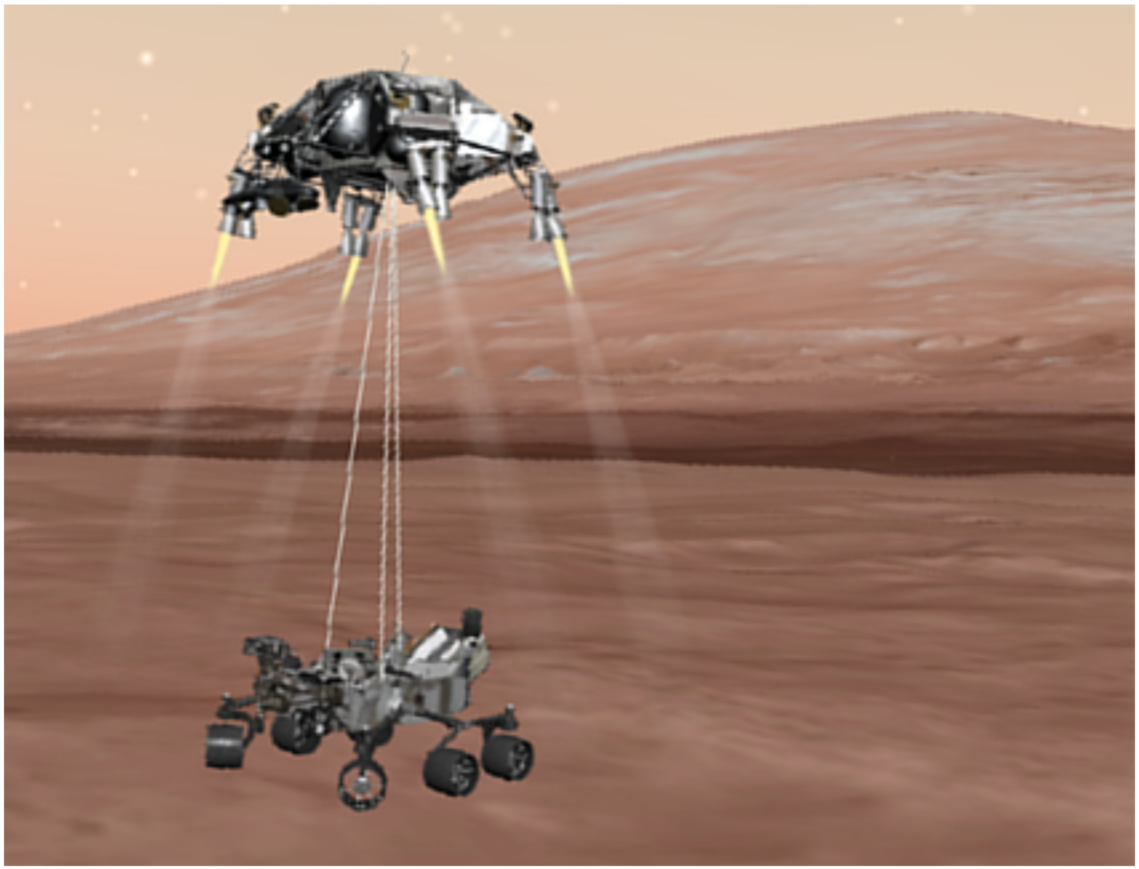
Daily Cycles of Radiation and Pressure at Gale Crater:
As pressure increases, the total radiation dose decreases.



Engineering Parameter: More than 5 km away from nuclear powered Curiosity



Proposed site satisfies engineering constraints, which is supported by successful landing of 899 Kg Curiosity.

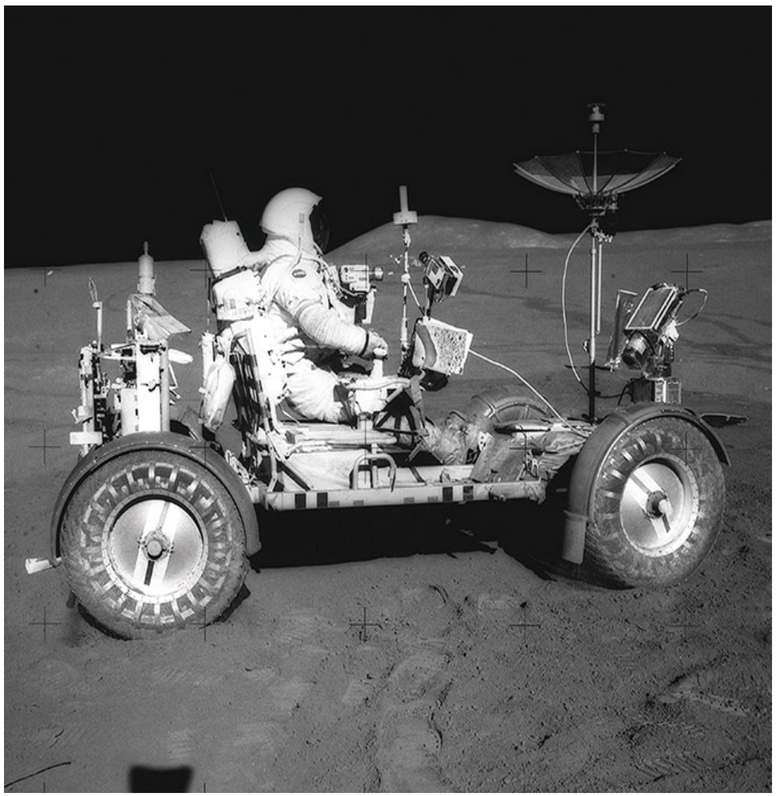


Elon Musk

Transportation & Mission in Exploration Zone(EZ)

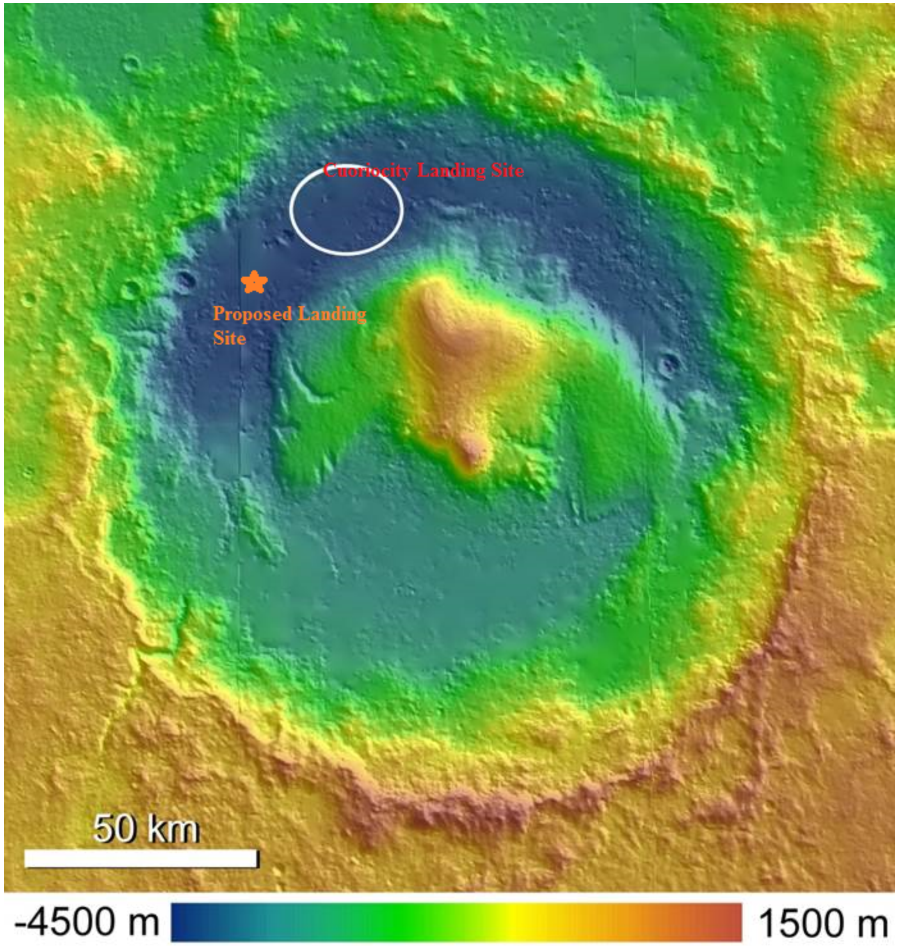
Mobility Type I: Wheeled vehicle

Apollo 15-Lunar Rover Vehicle (210 kg on earth) (1971)



Don’t forget spare tires!

Higher atmospheric density: Advantage on potential flying on Mars



Mobility Type II: Mars aircraft with faster rotating and bigger propeller with powerful battery

Con: Low atmospheric density **Pro: Low gravity**

Remote control robotic mission with sample return

Drone on Mars

Drone on earth

DATA NEEDS

Highest Priority EZ Data Needs

– We need additional data set to answer the following **science** question.

“Can any microbe survive in present Gale Crater?”

– We need additional data set to answer the following **resource** question.

“How deep should we dig in Gale Crater for enough water?”

Conclusion

Gale Crater is the Exploration Zone with

1) A proven safe landing site,
2) Rich scientific resources, and
3) Resources that support human missions.

Thank you for supporting

Gale Crater!!

Paul Yun